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New Brunswick
Nouveau-Brunswick

AN INVESTIGATION OF THE RESULT AND BENEFIT OF GRADING POTATOES INTO STORAGE

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EXECUTIVE SUMMARY

A project consisting of three aspects was carried out to investigate the benefits of grading potatoes immediately after harvest and prior to placing them into storage.

The work involved (1) discussions with packing house operators to determine the value and marketing problems associated with non Canada No.1 grade potatoes, (2) an analysis of a packing house operation to assess the occurrence of off-grade potatoes encountered in their operations over a period of years, and (3) an on-farm field experiment to determine the efficiencies associated with pre-grading potatoes using a mechanical sorter/bin piler.

The survey of packing house operators indicated that the current value for small potatoes is approximately $3.00 per barrel (165 lbs) if they meet Canada No.1 specifications. A value of $0.50/bbl ($0.30/cwt) was given for pickout potatoes. A major problem cited was the fact that regulations make it difficult to ship lower grade potatoes out of the province and that there is virtually no market for these potatoes within the province.

The analysis of packing house records indicated that, on average, approximately 30% of the potatoes encountered on the line were graded as cull and/or small potatoes. This is in contrast to a value of 11% derived from the experimental field work. This may be an indication of the magnitude of deterioration which occurs in potatoes during storage and/or in the packing house.

Based on the experimental field work, the cost of grading potatoes prior to storage was estimated to be approximately $2.80 per barrel. Discussions with packers indicated that, on average, the value of potatoes recovered (pick-outs and smalls) during the pre-grading process was in the order of $1.86 per barrel. On this basis then, there is no economic advantage to pre-grading.

Results of evaluation after storage showd no significant quality advantage to potatoes graded immediately post-harvest.

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1.0 INTRODUCTION

1.1 Existing Situation

Pre-grading (including sizing) of potatoes into storage is not a common practice in New Brunswick although it is standard practice in other potato producing areas. In years past, there was no particular need to segregate potato sizes, since the New Brunswick industry evolved around an efficient processing market that regularly provided an outlet for sizes not normally marketable as a table grade. More recently, however processors have been demanding higher quality potatoes for their operations, and have been offering smaller returns to producers for their "smalls" when included with standard sizes. Instances have also been cited in which producers were penalized for including "smalls" with the standard grades.

Other factors have also militated against pre-grading by New Brunswick producers. Pre-grading is often perceived as an activity which slows the movement of tubers into storage, to a rate which is below the harvest capacity of most producers. Since the harvest season in New Brunswick is strongly affected by deteriorating weather conditions, most producers view any activity which may retard harvest and storage as having little positive benefit.

A second factor relates to the configuration of most existing storages in New Brunswick. Specifically, most storages were not designed to handle two or more separate lots of tubers, each of which could be accessed independently throughout the marketing season, to supply customers on short notice. Rather most storages consist of a single large bin, with or without subdivisions, but which was not designed to facilitate independent access. Consequently, if a producer finds a market for a particular lot of potatoes, he must be certain that he also has a market for his other grades of potatoes, since once removed from storage they cannot be returned satisfactorily.

Unlike Prince Edward Island, much of New Brunswick's potato growing area is characterized by the presence of stony soil. Unless removed prior to storage, the stones play a significant role in reducing the quality of the tubers going into storage, as well as when they are being brought out for packing.

Currently, most producers make some effort, at least, to remove foreign material (stones, tops, and clods) from amongst tubers as they are going into storage. This in itself requires additional labour, equipment and time to accomplish. However, most producers now recognize the importance of piling "clean" potatoes in the bins.

Agriculture Canada engineers and scientists at the Fredericton Research Station have shown that foreign material, which accompanies tubers into storage, contributes to the deterioration of quality, even in well ventilated storages. Under these conditions the inter-tuber spaces become blocked, preventing the passage of air and thus promoting poor storage conditions.

It is clear that there is an increasing demand for higher quality commodities, including potatoes. If New Brunswick producers expect to increase, or even maintain their existing market share, greater efforts are going to be required in improving the quality of marketable potatoes.

Discussions with a number of producers and shippers indicate a strong interest in developing a protocol for grading tubers into storage. However, before investing in new storages or retrofitting existing storages, and before investing in the handling equipment required to accommodate the pre-grading concept, there is a strong need to quantify the benefits to be achieved, in terms of improvement in the quality of stored potatoes and in the economic returns which a producer can reasonably expect on such an investment.

1.2 Background to the Current Project

Through discussions with representatives of the public and private sector concerns in the New Brunswick potato industry, RPC became aware of the opportunity to undertake technical studies directed at improving the quality of the tubers marketed by New Brunswick farmers.

Further discussions culminated in the submission of a proposal to the Implementation Directorate of the Canada-New Brunswick Agri-Food Agreement by RPC in June of 1987. The proposal was approved for funding in September, 1987 at which time the project was mobilized.

2.0 OBJECTIVES

The objectives set for the project were stated as being:

- To assess the economic benefit and quality improvement to be achieved from pre-grading potatoes into storage for market optimization in New Brunswick; and

- To determine the effect of pre-grading Russet Burbank tubers into storage on marketable yield of stored product and on market optimization during the storage season.

3.0 APPROACH

To determine the effect of before-storage grading on potato quality, three related aspects of the problem were considered.

Initially, a survey of potato packing houses was undertaken to determine their requirements in the foreseeable future, and the extent to which cost recovery may be possible through the marketing of off-grade potatoes.

Secondly, it has been possible to gain access to the records of a potato packing operation that has recently ceased operation. The last eight years' grading data were analyzed to determine the extent of occurrence of off-grade potatoes delivered from several operations at various times.

Thirdly, experimental field studies were undertaken to determine the additional quantities of extraneous material which could be removed with more rigorous grading, and the extent to which grading prior to storage could improve the quality of potatoes taken out of storage.

4.0 PACKING HOUSE SURVEY

4.1 Methodology

In the spring of 1988, field interviews were carried out with 12 packers supplying potatoes to the fresh table market. Interviews were informal in nature, but the questionnaire attached as Appendix 1 was used as a guide.

The nature of this work was semi-quantitative as described in the following sections.

4.2 Results And Discussion

4.2.1 Consensus of Problems Identified from the Survey of Packing Line Operators

The consensus, of the packers interviewed, was that a number of events had conspired to affect the existing New Brunswick potato industry adversely. The most significant of these are related in the following discussion.

Because of the existence of an extremely strong and aggressive processing sector during the period of conversion to mechanical harvesting, bulk production has apparently pervaded the New Brunswick potato producer's perception of raising potatoes. Until recently, this perception has been unconsciously nurtured by the processors, who were accepting bruised and cut potatoes which would not be acceptable on the table stock market.

Over the last ten years the table stock consumer has become more demanding in terms of product presentation and quality, which has led to a premium price for washed and sized tubers. However, washing potatoes contributes significantly to the occurrence of grade defects and leads to increased cullage. Ultimately this results in smaller volumes of product available for marketing by the grower.

During the past decade Québec has introduced a "cost of production guarantee" to its potato producers. Not only has this led to increased production in the Province of Québec, but it has also fostered a more cavalier approach to potato marketing. With production costs guaranteed, Québec producers now offer their product for sale at what other Canadian producers regard as unrealistic prices. The effect of this has been to essentially force New Brunswick out of the Québec (Montréal) market which has led to an increase in efforts by New Brunswick producers to market their potatoes in the United States.

Taken together, these events have left the New Brunswick grower in a position where he is producing a non-premium potato at a time when the tablestock market is increasing the demand for better quality in potatoes and the subsidized competition in Québec has depressed the price available to New Brunswick growers. Because of the poor returns now coming to New Brunswick growers as a result of these events, they find it difficult to rationalize increased levels of investment to improve the quality of their products.

As a result of these circumstances some of the 1987 crop is being graded to Canada No.1 specifications and sold as Canada No.2 within New Brunswick, in order to compete with product from Prince Edward Island, which dominates the tablestock market. In addition, 1987 has seen an increase in farm sales of unwashed tablestock potatoes with a corresponding price reduction being taken by the producer.

Another difficulty contributing to lower returns is the inconsistency in marketing practice displayed by New Brunswick potato producers. Specifically, producers often withhold their product from market for long periods of time, awaiting an increase in price. This resultant lack of a consistent supply of quality product creates major problems for the shipper. Customers are added from year to year, and from the beginning of each season. Consequently, if the shipper's supply is interrupted for a period of time he must quickly locate another source. In doing so, he then has to offer a discount or make other concessions to regain the customer.

Having to sort through large volumes of potatoes to recover enough of a particular grade demanded by the market at a particular point in time, also creates a problem for packing line operators. Those operators interviewed, estimated the following breakdown of raw product delivered to their lines.[1]

Canada No. 1	- 53.5%
Canada No. 1 (smalls)	- 8.0%
Canada No. 2	- 8.5%
Pickouts	- 30.0%

1. The data presented here reflect the 1987 crop.

Approximately 50% of the weight delivered to the grading line is non-Canada No.1, with at least 30% of the total weight delivered having no market designation.

The consensus of all interviewees was that the New Brunswick potato producer must assume responsibility for delivering a better quality product, if there is to be a future for New Brunswick potatoes. This quality product, whether table or seed stock, will also have to be sized to a more specific market designation if it is to be acceptable. No significant improvement in price structure could be foreseen, other than a greater percentage of the crop moving at the higher priced grades. The price spreads between the different grades are largely dependent on the supply situation, as New Brunswick is not a "price setter but a price taker" in the potato market. Typical price spreads (per barrel) identified were as follows:

Canada No. 1	- $6.00
Canada No. 1 (smalls)	- $3.00
Canada No. 2	- $5.00
Pickouts	- $0.50

The cost of handling and shipping smalls was reported to be $3.00 per barrel, which is equal to the price shippers can expect for this product, therefore providing no value in the product for the producer. The breakdown of this cost is approximately as follows:

Handling:	$1.00
Transportation:	$1.00
Packing materials:	$0.50
Brokerage & margin:	$0.50
	$3.00

No improvements in this trend could be foreseen by those interviewed.

4.2.2 Consensus of Solutions to Problems Identified from the Survey of Packing Line Operators

The solutions to improving returns to the New Brunswick potato producer, as perceived by packing line operators, can be summarized in two categories as follows:

1. Solutions to Improve Market Returns to the Grower.

A) Seed Crop Certification

The entire New Brunswick crop should be produced and inspected to provide minimal seed certification on each variety of potato. This would probably not result in a significant increase in cost but would greatly increase the marketing options available to producers since they would then have seed markets available to them in addition to the tablestock and processing markets. (This may only be cost effective for round white and coloured flesh varieties.)

B) On-farm Grading

Because of quality demands, grading by the farmer is becoming more critical in terms of cost effective marketing, whether grading into storage or out of storage.

The choice between grading into storage or out of storage would depend largely on the individual production system. This would also suggest sizing as follows:

Seed or Russets - up to 2 inches, and 3 inches and over;
Round whites - up to 2 inches

The exact size would vary with the season and whether the potatoes were being graded into storage or out of storage.

With some form of on-farm grading the farmer would retain possession of the various sizes and grades, thus increasing his control over marketing options. The producer would be able to recover something for the effort of handling, such as utilizing the pickouts for livestock feed or delivering smalls to the best available market.

C) Secondary Processing of Canada No. 2 Stock in New Brunswick.

Under existing regulations, potatoes graded lower than Canada No.1 are prohibited from export outside the province. However if these lower grade potatoes are processed into some form of value-added product, these can be exported over provincial boundaries. Accordingly, increasing the opportunities for secondary manufacturing could lead to expansion of the markets for the lower grade potatoes.

D) Reduce Supply.

Reducing the supply of potatoes would probably lead to an increase in price. However, reducing the supply would also imply the introduction of a supply managed commodity system involving quotas. Analyzing the validity of this approach is clearly beyond the scope of the current project.

E) Establish a Minimum Price to the Grower.

Establishment of a minimum price to the grower would reduce the ease with which a dealer/broker/ shipper could overstock and attempt to sell potatoes for a small discount.

2. Solutions to Improving the Quality of Raw Product Delivered

Discussions with the packing line operators led to the formulation of the following suggested solutions for improving the quality of potatoes delivered by producers to packing houses.

A) There is an urgent need for grower education on changing market demands and the production techniques needed to meet these demands. It must be remembered that, if on average the industry is depressed, there are, at least, some individuals who are meeting the challenge and surviving. It was suggested that mandatory on-farm grading could bring about an improvement since the producer would be confronted with the quality issues involved.

B) Machine/System Design Improvements.

There is ample evidence which illustrates that with existing harvest, storage and packing systems tubers experience considerable mechanical damage. Efforts at improving the design of equipment used in handling potatoes could lead to significant reduction in levels of mechanical damage.

C) Earlier Maturing, High Yielding Long White (Russet) Potato Variety.

Because of an insufficient number of degree/days, in New Brunswick's potato belt to permit harvesting of Russets prior to the onset of deteriorating autumn weather, current harvests are undertaken with considerable haste. The implication here is that because of the compressed harvesting timeframe, the level of care devoted to harvesting, grading, cleaning and storage of tubers is considerably less than what might otherwise be considered good practice. One solution to this problem would be the development of an early maturing variety which would permit harvesting earlier in the autumn and thus obviate the need for the "panic" approach to getting potatoes harvested and into storage.

D) Support Programs to Promote Crop Rotations and Expand the Unit Land Base.

It is recognized that the optimal potato crop rotation system for New Brunswick involves one year potato production followed by two years of a soil improving crop. However, because of the need to produce large acreages (to compensate for low prices), growers are using a two year rotation system rather than a three year system. This has, reportedly, resulted in an ongoing deterioration of favorable soil conditions with a concomitant decrease in yield and quality of potatoes. A program directed at improving the rotation system and/or expanding the land base devoted to potato production could be of significant benefit to the industry.

5.0 REVIEW OF PACKING LINE RECORDS

5.1 Methods

The records of a New Brunswick potato packing company were analyzed for an eight year period (1978/79 to 1985/86) to determine the relative percentage of Canada No. 1, "Pickouts" and "Smalls" delivered. Producers who delivered to the company over a number of successive months and years were selected in an attempt to provide for some consistency in the quality of the data used. In all, records from fourteen producers were used to complete the data sets for each year.

5.2 Results of the Review of Packing Line Records

The results of this analysis are presented in Table 5.1 which indicates that the percentage (expressed as a yearly average) of Canada No.1 potatoes delivered ranged from 47.9% to 74.4%. An analysis of variance (Table 5.2) showed differences in yearly values to be significant. The percentage of smalls ranged from 10% to 15% over the same time period. There was no apparent significant increase in the percentage of smalls over the storage period.

The percentage of non-marketable tubers (culls) ranged from 25.6% to 52.1% over the eight year period. On average, the percentage of culls showed an increase over the storage period, but no statistically significant trends were in evidence.

The overall average partitioning of the potatoes for the period was as follows:

Canada No 1. - 66%
Smalls - 12%
Culls - 22%

The records available did not identify the proportion of smalls that were of Canada No.1 quality grade. Consequently it could be assumed that approximately 22% of the smalls would have a grade defect greater than Canada No.1 tolerances. On this basis then, approximately 25% of the weight of potatoes delivered to a table stock packline would receive a non-marketable or cull designation.

TABLE 5.1 - REVIEW OF PACKING LINE RECORDS

1978-1979	October	November	December	January	February	March	April	May	YR. AVG.
Avg. Weight		270675	654170	600283	306407	186853	501642	177618	385378
Avg. % Culls		22.75	17.08	22.13	21.50	22.08	22.15	19.94	21.09
Avg. % Smalls		11.13	14.17	13.50	11.25	16.58	11.95	12.38	12.99
Avg. Canada #1		66.13	68.75	64.38	67.25	61.33	65.90	67.69	65.92
1979-1980									
Avg. Weight	108967	158038	578417	373858	383252	172683	156970	53050	248154
Avg. % Culls	16.75	21.75	22.35	23.96	18.40	19.67	28.88	24.50	22.03
Avg. % Smalls	12.83	14.00	15.70	13.79	14.25	17.00	11.54	9.08	13.52
Avg. Canada #1	70.42	64.25	61.95	62.25	67.35	63.33	59.58	66.42	64.44
1980-1981									
Avg. Weight	139460	280450	212070	103160	159470	228395	295977		202712
Avg. % Culls	20.75	23.75	26.33	25.75	18.67	19.44	17.17		21.69
Avg. % Smalls	16.50	11.94	10.25	11.58	11.50	13.00	14.83		12.80
Avg. Canada #1	62.75	64.31	63.42	62.67	69.83	67.56	68.00		65.51
1981-1982									
Avg. Weight	221728	235124	771663	308570	238887	891005	299613	245900	401561
Avg. % Culls	17.63	24.15	21.08	18.25	24.38	25.13	20.67	20.67	21.49
Avg. % Smalls	5.38	7.95	11.17	14.13	10.08	11.38	8.25	11.67	10.00
Avg. Canada #1	77.00	67.90	67.75	67.63	65.54	63.50	71.08	67.67	68.51
1982-1983									
Avg. Weight	417803	942421	294640	181083	247490	284345	256693	164665	348642
Avg. % Culls	43.50	46.25	34.88	33.42	45.33	36.00	43.13	41.38	40.48
Avg. % Smalls	8.88	7.00	11.13	11.17	15.00	15.00	12.50	12.00	11.58
Avg. Canada #1	47.63	46.75	54.00	55.42	39.67	49.00	44.38	46.63	47.93
1983-1984									
Avg. Weight		203677	172625	326223	67100	167796	385761	71090	199182
Avg. % Culls		14.00	11.00	13.42	17.00	14.45	12.92	15.25	14.00
Avg. % Smalls		11.75	21.50	14.00	9.75	15.05	17.50	15.50	15.01
Avg. Canada #1		74.25	67.50	72.58	73.25	70.50	69.58	69.25	70.99
1984-1985									
Avg. Weight	290485	738070	92325	314810	231751	93170			293435
Avg. % Culls	15.25	16.17	15.50	24.25	17.42	14.92			17.25
Avg. % Smalls	13.38	14.33	15.75	11.63	18.33	16.42			14.97
Avg. Canada #1	71.38	69.50	68.75	64.13	64.25	68.67			67.78
1985-1986									
Avg. Weight	135765	653048	1267545	229693	320656	235650	338576	476695	457203
Avg. % Culls	8.75	12.44	11.88	19.31	15.90	13.88	19.63	20.88	15.33
Avg. % Smalls	10.75	7.06	7.13	6.56	7.30	7.42	23.44	12.56	10.28
Avg. Canada #1	80.50	80.50	81.00	74.13	76.80	78.71	56.94	66.56	74.39

Avg. all 8 Years	October	November	December	January	February	March	April	May	
Avg. Weight	219035	435188	505432	304710	244377	282487	319319	198170	313590
Avg. % Culls	20	23	20	23	22	21	24	24	22
Avg. % Smalls	11	11	13	12	12	14	14	12	12
Avg. Canada #1	68	67	67	65	65	65	62	64	66

TABLE 5.2
ANALYSIS OF VARIANCE OF YEARLY PERCENTAGE
OF CANADA NO. 1 POTATOES

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Totals
Sample site (n)	24	38	25	30	21	24	15	31	208 (N)
Average % #1	65.91	63.809	65.39	69.208	48.607	71.656	67.717	73.927	
Std.dev.	5.797	6.071	5.827	5.488	7.99	5.164	5.085	12.011	
$(\Sigma x)n$	1582	2424	1634	2076	1020	1719	1015	2291	13765 (Total)
$(\Sigma x^2)n$	10503	156085	107711	144566	508943	123844	69145	173751	931050 (Σx)
$T=\frac{(\Sigma x)^2}{n}$	104280	154721	106596	143693	49615	123230	68783	169423	920644 (ΣT)

Grand Mean = 66.1815

$C = (\text{Total})^{2}/N$ = 911037

$SS = \Sigma x2 - C$ = 20013

$SST = \Sigma T - C$ = 9606.75

SSE = SS - SST = 10406.26

k = no of groups = 8

n = Average Sample site = $\frac{\text{Total \# of Samples}}{\text{no. of Groups}}$

$= \frac{208}{8}$

$= 26$

$F = \frac{SST\ (k(n-1))}{SSE\ (k-1)} = \frac{9606.75 \times 8 \times 25}{10406.26 \times 7} = 26.37$

Required F value for significant difference = 1.79

The [illegible] differences between years are highly significant

6.0 EXPERIMENTAL POTATO GRADING

In October 1988 an experimental program was carried out to determine the quantity of off-grade potatoes that could be removed with increased grading effort, and the extent to which this could contribute to an increase in the quality of the potatoes when brought out of storage.

6.1 Methodology

The experiments were carried out at the cooperant's potato storage which was divided into four bins.

Potatoes were handled in the following manner:

i) Potatoes were harvested in the field and loaded onto a standard bulk body and transported (approximately 1/2 hour) to the storage.

ii) Potatoes were unloaded from the truck into the dirt eliminating conveyor on the harvest sorting machine.

iii) Potatoes passed from the dirt eliminating conveyor over a sizing conveyor. This conveyor consisted of a chain-link belt with openings sized to separate small potatoes. Initially, the opening size was 1 5/8". During the second half of the experiment the screen size was increased to 1 15/16" to allow for a greater degree of separation of small potatoes.

iv) After passing over the sizing conveyor, the potatoes were directed over a roller conveyor bed where they were manually graded to remove damaged or misshapen potatoes, as well as rocks and dirt.

v) The potatoes were then delivered to a discharge conveyor which carried them to a canvas chute that guided the tubers into the storage.

Upon arrival at the storage, full potato trucks were weighed. The trucks were also weighed empty once each day during the experiment. This permitted calculation of a gross weight of potatoes delivered to the storage.

Unacceptable potatoes and foreign material (rocks and dirt) were removed at three locations: (1) at the dirt eliminator, (2) at the conveyor discharging potatoes from the sizing conveyor, and (3) from the grading table. For each truckload delivered, the weight of potatoes, as well as rocks and dirt from each location was recorded. This permitted calculation of the amount of material removed during grading.

Essentially, the experiment consisted of segregating two groups of potatoes, that have been subjected to different grading procedures prior to being placed in storage. In the first instance, the potatoes were delivered from the truck to the storage with very little grading. In the second, potatoes were carefully graded for smalls and also exposed to a more rigorous hand grading to remove unacceptable potatoes and foreign material.

Nine 10kg samples were taken from each truckload. Three samples were taken directly as the potatoes were being discharged from the truck. Six samples were taken immediately before the potatoes were placed in storage, examined and then three of them were placed in the storage pile. The remaining three samples of this group, along with the three samples from the truck discharge, were taken by Agriculture Canada technicians for determination of mechanical damage. All of the samples were weighed and a record kept of the amount of rocks and dirt in each sample.

The data were processed to show, on a bin-by-bin basis, the total weight of potatoes unloaded, the total amount of foreign material and rejected tubers at each location on the grading machine, and the net weight of potatoes in storage.

After being stored for the winter, the potatoes were removed from the storage and marketed through normal channels. At the time of marketing the industry was experiencing poor markets and depressed price levels. Consequently the potatoes were kept in storage until June, 1988, which left ample time for any differences in quality between the two groups to become apparent. It had originally been intended that the potatoes would be marketed in their entirety to tablestock packing houses from whom comparative grade data would be generated during the normal course of their operations. Due to market conditions this was not possible and the bulk of the potatoes were purchased by McCains Limited for instant mashed potato production which does not entail the same type of grading as that carried out by packing houses. Nonetheless, some limited data were gathered from packing houses for graded and ungraded potatoes. In addition, McCain Foods Limited kindly agreed to grade samples from each truck load of potatoes removed from the storage. These samples were graded by two different methods. Firstly, the standard grade procedure for smalls, culls and defects and rot applied by McCains' to the bulk of its potatoes for processing was carried out. As well, a "bruise free" test was carried out, wherein the potatoes were steam peeled and the yield of bruise free potato flesh was determined.

Each truckload of potatoes removed from storage was weighed to allow determination of total weight loss during storage. Weight loss figures were also obtained from the samples, which had been placed in netted bags in storage, which were weighed to determine weight loss and then forwarded to Agriculture Canada for their examination.

6.2 Results and Discussion - Experimental Work

The results of records taken at the time of grading are presented in Table 6.1. The quantities of small and cull potatoes removed before storage in bins 3 and 4 show a marked increase. This is attributed to the increased grading effort. The indication is that 11% of the potatoes delivered to the storage were substandard. Further this 11% was split between 6% small and 5% cull potatoes. Observations at the time indicated that the bulk of the culls were large, misshapen potatoes.

Using a value of $3.00/bbl for smalls and $0.50/bbl for culls, the recovered potatoes represent a composite value of $1.86/bbl ($1.13/cwt).

TABLE 6.1

RESULTS OF POTATO GRADING TRIALS

Bin	#	Total Wt Delivered	Rocks(1) Sand	Scrap(2) Potatoes	Small(3)	Culls(4)	Net. wt.
1	wt	87107	1306	294	95	280	85132
	%		1.5	0.3	0.1	0.3	97.7
2	wt	93079	1451	22	102	278	91226
	%		1.6	0	0.1	0.2	98.0
3	wt	151408	1993	935	7074	865	132756
	%		1.3	.6	4.6	5.7	87.6
4	wt	83690	379	130	4390	5161	73630
	%		0.4 (5)	0.1	5.2	6.2	87.9

NOTES

1) Rocks + Soil - total weight from various collection points.
2) Scrap Potatoes - Broken potatoes gathered from the dirt eliminator and from under the truck
3) Smalls - Small potatoes from sizing conveyor. After bin #2 the size of conveyor was changed from 1 5/8" to 1 13/16" openings.
4) Culls - Potatoes rejected during manual grading consisting mostly of large deformed potatoes.
5) Not all rocks and dirt were collected from last load due to poor weather and equipment problems.

Separate data are provided in Table 6.2 for the weight of rocks removed, with and without extra grading effort. Overall, the weight of rocks in potatoes delivered to the storage did not exceed 2.5%. Over half of this was removed with the type of manual inspection traditionally carried out as potatoes are put into storage. With more grading effort, virtually all of the rocks were removed.

TABLE 6.2

OCCURRENCE OF ROCKS
BEFORE AND AFTER SORTING

BIN #	BEFORE SORTING	AFTER SORTING
1	2.41%	1.08%
	0.58%	0.18%
Average of 1 & 2	1.495%	.63
% Reduction after Sorting	57.8%	
3	.04%	
4	1.01%	0%
Average of 3 & 4	.905%	.02%
% Reduction after Sorting	97.8%	

The samples taken by the Department of Agriculture were graded both for mechanical damage and for grade defects. The results are shown in Table 6.3. The overall grade index for the graded potatoes was in fact slightly lower for ungraded potatoes than for the graded potatoes. However, the difference was not large.

TABLE 6.3

RESULTS OF AGRICULTURE CANADA GRADING

% OF SAMPLE

	UNGRADED (BIN 1)	GRADED (BIN 3)
No Damage	32.8	30.5
Scuff	17.4	16.5
Peeler	18.9	19.1
Severe	30.9	33.9
Canada #1	69.0	65.8
Grade	81.3	81.3
Small	10.6	12.1
Misshapen	3.7	2.4
Disease	4.5	4.3
Index	290.6	311.1
# of Samples	38	38

	UNGRADED (BIN 2)	GRADED (BIN 4)
No Damage	31.4	28.8
Scuff	12.9	12.7
Peeler	21.1	21.9
Severe	34.6	36.6
Canada #1	69.4	71.3
Grade	84.8	87.4
Small	8.6	5.2
Misshapen	4.4	1.5
Disease	2.1	6.0
Index	318.6	334.7
# of Samples	54	54

* Blackspot is not relfected in this table

A record of the truck loads of potatoes that were removed from the storage, including the bin, date, truck net weight and available grading information, is shown in Table 6.4. As may be seen, only six of the seventeen truck loads were delivered to tablestock packing houses where information on final pack grade could be obtained. This information is summarized in Table 6.5, which indicates that it was not possible to perceive a difference in grade between the potatoes that had been graded and those that had not.

The weights of potatoes removed from storage were compared to the weight of potatoes originally stored to determine total weight loss. A summary of this information if given in Table 6.6. The average loss in weight was approximately 30% with no significant difference in weight loss in graded and ungraded potatoes

A total of 92 samples in netted bags was recovered from the potatoes removed from storage. These samples were weighed and the weight compared with the weight into storage. The graded potatoes showed a average weight loss of 11.8%, compared with a weight loss of 14.8% for the ungraded potatoes (Table 6.7). However, high standard deviations among the sample populations indicate that these results are not likely to be statistically significant.

The results of the grading carried out by McCain Foods Limited are shown in Table 6.8 and 6.9. Table 6.8 shows a summary of the results following their standard grading method. The percentage of culls and defects amounts to 22.15% in the graded sample versus 19.5% in the ungraded sample. However, because of the small numbers involved in the sample, this result is probably not significant. It is interesting to note however, that the percentage of rot was markedly lower in the graded potatoes. As one would expect the graded potatoes contained fewer smalls than the ungraded potatoes. On balance, however, there did not appear to be a distinct quality advantage to the potatoes which were graded before storage. Again this may be a relection of the small sample size.

Table 6.9 shows the results of the bruise free test conducted by McCain Foods Limited. The ungraded potatoes showed a bruise free yield of 53.7% versus a yield of 52.1% for the graded potatoes. It is felt, however, that the difference between these results is not significant.

In summary these results indicate that on the basis of quantitative tests, potatoes graded prior to being stored did not show any quality advantage from either weight loss during storage or in terms of the level of culls and defects occurring after storage. There was, however, some slight benefit in the amount of rot occurring during storage.

TABLE 6.4

RECORD OF POTATOES REMOVED
FROM STORAGE

(WEIGHT IN KILOGRAMS)

LOAD/BIN		DATE (JUNE)	TRUCK	NET WT	CULLS	SMALLS	#1	%CULLS	%SMALLS	%#1	PACKER
1	3	6	Gypsy Rose	20585	10482	1347	8756	50.9	6.5	42.6	Culberson
2	3	6	Reuben Jane	14928				28	7.5	64.5	Gem Vac
3	3	6	Patches	11270	5538	1871	3861	49.1	16.6	34.3	Culberson
4	1	6	Reuben Jane					40.5	14	45.5	Gem Vac
5	1	7	Gypsy Rose					59.75	15.75	24.5	Gem Vac
6	2	9	Vails Truck	19114							McCains
7	3	9	Gypsy Rose	13017	8457	2619	1941	65.0	20.1	14.9	Culberson
8	1	9	Reuben Jane	13789							McCains
9	4	10	Vails Truck	18398							McCains
10	1	10	Gypsy Rose	19922							McCains
11	4	13	Patches	12750							McCains
12	3	13	Gypsy Rose	19777							McCains
13	2	14	Gypsy Rose	20902							McCains
14	4	14	Reuben Jane	14879							McCains
15	4	16	Reuben Jane	12419							McCains
16	4	16	Gypsy Rose	20745							McCains
17	2	16	Reuben Jane	2800 (est)							McCains

Note: Potatoes sold to McCains were used for instant mashed potato production and thus were not graded.

TABLE 6.5

SUMMARY OF AVAILABLE RESULTS
FROM PACKING HOUSE GRADING

BIN (GRADED/ UNGRADED)	PACKER	CULLS	SMALLS	#1
3 (G)	C	50.9	6.5	42.6
3 (G)	C	28	7.5	64.5
3 (G)	C	49.1	16.6	34.3
3 (G)	C	25	20.1	14.9
AVERAGE GRADED (STANDARD DEVIATION)		48.25 (15.3)	12.7 (6.7)	39.1 (20.5)

BIN (GRADED/ UNGRADED)	PACKER	CULLS	SMALLS	#1
1 (U)	G	40.5	14	45.5
1 (U)	G	59.75	15.75	24.5
AVERAGE UNGRADED		50.1	14.9	35

TABLE 6.6

TOTAL WEIGHT LOSS
DURING STORAGE

(BASED ON TRUCK WEIGHTS)

BIN#	WEIGHT IN	WEIGHT OUT	%WEIGHT LOSS
1	85132	66777	21.6
2	91226	57695	36.7
1 & 2 (UNGRADED)	176358	124472	29.4
3	132756	79577	40.1
4	73630	64312	12.6
3 & 4 (GRADED)	206386	143889	30.28
TOTAL	382744	268361	29.9

TABLE 6.7

WEIGHT LOSS DURING STORAGE

(BASED ON SAMPLES)

BIN#	GRADED/UNGRADED	AVERAGE % WT LOSS	STANDARD DEVIATION
1	UNGRADED	15.448%	10.6%
2	UNGRADED	14.109%	11.07%
AVERAGE UNGRADED	14.8%		
3	GRADED	10.921%	10.42%
4	GRADED	12.668%	3.27%
AVERAGE GRADED	11.8%		

TABLE 6.8

SUMMARY OF RESULTS OF
GRADING BY MCCAINS

BIN	% CULLS AND DEFECTS	% ROT	% SMALL	% ACCEPTABLE
1	20.9	4.3	13.0	61.8
2	18.0	7.8	12.8	61.4
AVERAGE UNGRADED	19.5	6.1	12.9	61.5

BIN	% CULLS AND DEFECTS	% ROT	% SMALL	% ACCEPTABLE
3	19.5	4.4	6.7	69.4
4	24.8	2.4	7.4	65.4
AVERAGE GRADED	22.15	3.4	7.05	67.4

TABLE 6.9

SUMMARY OF RESULTS OF
BRUISE FREE TESTS
BY MCCAINS

BIN		% BRUISE FREE
1		47.9
2		65.8
AVERAGE UNGRADED	53.7	
3		58.0
4		47.7
AVERAGE GRADED	52.1	

7.0 ECONOMIC ASSESSMENT

7.1 An Evaluation of Possible Markets and Values of Off-Grade Potatoes

To ship potatoes out of New Brunswick, international and provincial boundaries have to be crossed. To meet the requirements of out-of-province regulators, potatoes must be graded to either a Canada No.1 or Canada No.2 designation, with or without concessions and tolerances. The Canada No.1 "small" designation is applied to potatoes meeting No.1 Grade standards for condition and defects, but which do not meet the size requirement. Canada No.2 Grade standards are less stringent with respect to condition, defects and size. Accordingly, it is difficult to ship Canada No.1 "smalls" or "pickouts" out of the province.

These regulatory obstacles also make it difficult to estimate the price that can be recovered for lower grades of potatoes. The figures presented below represent values quoted by packline operators, together with a calculation of the value of potatoes as livestock feed (Appendix 2).

Discussions with the packline operators (Section 4.2.1) indicated that the pricing structure offered to the growers was:

Canada No. 1	- $6.00
Canada No. 1 (smalls)	- $3.00
Canada No. 2	- $5.00
Pickouts	- $0.50

Further analysis, taking into account the nutritional value of the respective feeds given in Appendix 2, would suggest that pickouts have a potential value as livestock feed of 75 ¢/cwt relative to barley at $5.25/cwt. If however, these potatoes were moved off the farm, most of this small value would be quickly consumed by the handling and transportation costs.

The reported value for smalls and pickouts may also be hypothetical because the existing packlines normally offer prices to the producer based on the weight of Canada No.1's delivered. The recovery from smalls, pickouts Canada No.2, (unofficially) and 8 oz. and up, effectively provides packing houses with their operating margins.

Therefore, if producers began to deliver segregated lots to the market, the pricing structure of existing packlines would have to be recalculated. It is very likely that a margin would be introduced or widened on Canada No.1 deliveries. Presumably the extent of this margin would depend on the loss of income to the packline and any reduction in operating cost associated with handling this product.

The market for non-Canada No.1 table grade potatoes for secondary processing in New Brunswick is small. It consists essentially of McCain's, a starch factory, Acadian Fricot, and a few other small food processors. The absolute volume of this market or its potential for increase has not been established.

There appears to be a small market for off-grade potatoes in Ontario and in the southern United States for soup and stew production. At present though, it appears that the price attainable from these markets is consistent with the price offered by the potato packing houses. Thus these markets should probably be considered as an avenue for increased volume of sales, rather than a source of higher returns.

7.2 Estimated Net Value of On-Farm Grading

The experimental work for this project was carried out during the course of a commercial potato storage operation. It is thus possible to estimate the extra labour required to grade potatoes into storage.

Over six 10 hour working days, a total of 415,284 kg (915,535 lb) of potatoes were put into storage. Results of the grading trials indicates that approximately 6% were recovered as small potatoes and 5% as cull potatoes. To accomplish this, 4 extra workers were required

An analysis of the cost and benefit of grading, based on these data, is given in Table 7.1. This shows that the cost of grading is approximately 1.2 ¢/lb based on the weight recovered, and that for the operation studied there was a net loss of $70 based upon a value of smalls at $3.00/bbl (1.81/cwt) and culls at $0.50/bbl ($0.30/cwt).

It should be noted that the field harvested in the current project had difficult soil conditions and was some distance from the storage. In addition, there was only one harvester in operation during the study. Thus, under more favorable circumstances it could be possible to carry out grading with greater efficiently.

A further estimate has been made of machinery costs to remove all culls. This analysis is presented in Table 7.2. It is estimated that the machinery cost for pre-grading amounts to approximately 1/2 ¢/lb recovered. Thus the total cost including labour and machinery equates to approximately 1.7¢/lb (or $2.80/bbl) of potatoes recovered.

In summary, there does not appear to be economic incentive for recovery of off-grade potatoes at the producer on the basis of the product recovered at time of storage.

After removal from storage no significant benefit of grading prior to storage was perceived.

TABLE 7.1

ESTIMATED LABOUR TO PROCESS CULLS

Extra Labour

6 days x 4 men x 10 hrs/day x $5/man/h = $1200

Estimated Recovery

Total Potatoes Processed 41,5284kg. = 915535 lbs.
Potential Small Recovered (6%) 54,932 lbs.
Potential Culls Recovered (5%) 45,777 lbs.

Value of Recovery

Smalls 54,932 x $1.81/cwt = $ 994.27
Culls 45,777 x $0.30/cwt = $ 137.33
$ 1131.60 ($1.13/cwt)
Net Benefit (68.40)

Cost per lb Recovered

$$\frac{\$1200}{(54,932 + 45,777)} = \$0.012/\text{lb.}\ (\$1.20/\text{cwt})$$

TABLE 7.2

ESTIMATED INCREMENTAL
EQUIPMENT COST

Harvest Sorter		
Machinery Cost		
$40,000 depreciated over 10 yrs		$4000
Maintenance		$1000
		$5000/yr.
Standard Bin Piler		
Machinery Cost		
$25000 depreciated over 10 yrs		$2500
		$ 500
		$3000
	Incremental cost	$2000/yr.
Typical Potato Operation		
150 acres @ 28000 lbs./acre	3,750,000	
Smalls recovered 6% value @ $1.82/cwt	225,000	
Culls Recovered 5% value @ $0.30/cwt	187,500	
Net Benefit (excluding labour) (after laboring costs @ 1.2¢/lb)		

Costs per Pound Recovered

$$\frac{2000}{(225000 + 187,500)} = \$.0048/\text{lb} \ (\$0.48/\text{cwt})$$

The analysis does not take into account the value of smalls and the culls that may be recovered after storage, or the extent to which pre-grading improves quality after storage. These factors will be examined when data are available after the potatoes have come out of storage.

8.0 CONCLUSIONS

A survey of potato packing houses has shown that they are currently unable to offer a significantly higher price to farmers for their potatoes. This is said to be because of the sporadic and uncertain nature of markets for small or off-grade potatoes, as well as a regulatory regime that limits the opportunities to sell these products. However the consensus of opinion was that some degree of on-farm grading (or size differentiation) will be essential to remain competitive in the market.

The packers unanimously agreed that the best way to significantly improve quality would be at the primary producer level. Specifically, if quality is lost prior to delivery to the packer, it is not possible to recover it afterwards.

The breakdown of product coming to the packers was estimated to be as follows:

Canada No. 1	- 53.5 %
Canada No. 1 (smalls)	- 8.0
Canada No. 2	- 8.5 %
Pickouts	- 30.0 %

A review of detailed records for eight years' operation of a potato packing house showed the average occurrence of smalls to be 12 % and culls 22 %.

An experimental trial of grading potatoes into storage showed that small and cull potatoes could be recovered at rates of approximately 5 % and 6 % respectively. The efficiency of removal of rocks was also increased from 58 % to 98 %.

Evaluation upon removal from storage did not show significant differences between groups of potatoes on the basis of packed quality, weight loss or "bruise free" test. Samples examined by McCains showed lower incidence of rot and smalls in pre-graded potatoes but levels of culls and defects equivalent to ungraded potatoes.

It was noted with considerable interest, that the records for potatoes delivered to the packing house indicated a substantially higher cull rate than was observed during the project field study. This may be interpreted to mean that the conditions under which the experimental field work undertaken in this project were atypical, or that the packing house workers are more efficient at grading than the farm workers. Otherwise the indication is that there is deterioration in quality of the tubers during storage, or that there is significant damage occurring during the operations of the packing house.

In reality each of the above is probably a contributing factor. However, it would be useful to be able to partition these causes more accurately as a prelude to developing remedies for them.

An estimate of the cost incurred to carry out pre-grading, under the particular conditions experienced during the course of the experimental work within this project, showed the labour component to be 1.2 ¢/lb and the capital cost to be 0.5 ¢/lb. This corresponds to a cost of $1.70/cwt ($2.80/bbl) which does not compare favorably with the composite value of $1.13/cwt ($1.86/bbl) which would be received by the grower for the smalls and pickouts recovered during the pre-grading operation. The composite value utilized here is based on market information, supplied by packers, which indicated that $1.81/cwt ($3.00/bbl) could be expected for small potatoes, and that $0.30/cwt ($0.50/bbl) was a reasonable expectation for pickouts. However, these values are at best,tentative, since there are several factors impinging on them, not the least of which are regulatory considerations.

Given that a significant proportion of the recovered material is of little value, it is concluded that there is no return for this effort under present market conditions. Results of evaluation upon removal from storage indicated no significant quality advantage to the pre-graded potatoes.

9.0 SUGGESTIONS FOR FURTHER WORK

Based on the conclusions reached in this project, the following suggestions are offered for furthering the aim of increasing the quality of New Brunswick produced potatoes.

1) Conduct a pilot project to offer a premium price for No.1 small potatoes, with a view to determining their availability and the market potential when they are made available in adequate quantities.

2) Undertake a study to determine factors contributing to off-grade potatoes.

3) The manufacturer of the grading machine used in this project has suggested that this unit was not particularly suited to the existing conditions posed by the cooperant's farm. Accordingly, it may be appropriate to undertake a subsequent project utilizing the recommended model of destoner /planter followed, during harvesting, by the recommended grader. There would be some considerable advantage realized if these machines could be acquired on a demonstration or rental basis.

4) An alternative to the above could be consideration directed at designing and developing a unit specifically adapted to operating in the stony soil conditions characteristic of New Brunswick potato growing areas. One local manufacturer has already expressed interest in manufacturing such a unit if a workable design could be developed.

5) Review the operations of cooperating packing houses to determine the extent and circumstances surrounding mechanical damage occurring in potatoes moved across their lines. Develop some workable solutions to reduce the amount of damage which occurs on the packing lines.

APPENDIX I

QUESTIONNAIRE FOR GRADING OF POTATOES INTO STORAGE

NAME _____

ADDRESS _____

INTERVIEWEE _____

1. What potato grade classifications other than Canada No. 1 are offered and what is the accepted market terminology to designate each non Canada No. 1 category?

2. What percentage share does each grade classification typically represent in overall annual volume?

3. Have market opportunities for off-grades improved in recent years?

4. Which of the non-Canada No. 1 grade classifications offers improving market potential?

5. What price levels/relationships do off-grades have and what trends are evident?

Will the trend continue? _____

6. What changes need to be made to facilitate market development and exploitation? What is expected cost

APPENDIX II

ESTIMATED VALUE OF PICKOUTS AS LIVESTOCK FEED

Motivation for on-farm grading of potatoes could be increased if the producer's effort resulted in a higher gross return from the volume produced. An analysis of the price relationship between barley and potatoes in an optimum beef production system is presented in this Appendix. This analysis suggests, that at current and near future barley prices, potatoes are worth less than $0.005 per kg as a livestock feed source. Assuming a typical potato grade distribution as reported by pack line operators, with barley valued at $5.25/cwt, cull potatoes would be worth $0.75/cwt ($1.23/bbl) on site as livestock feed, as illustrated in Table 1. With grain valued at $3.00.cwt, the corresponding value for potatoes would be $0.60/cwt ($0.99/bbl).

Considering the cost of adapting to feed potatoes, and increased wear on metal components of any feed system there is no real margin on which a livestock feeder could convert to a potato based ration. Also at the low level of net return from Table 1, there is no real incentive for a potato producer to consider investment in a potato grading capability on-farm.

OPTIUM BEEF PRODUCTION SYSTEM ANALYSIS

Grain($/lb)	0.0525	YARDAGE:			
Prot. Conc.($/lb)	0.18	Build.($10/sq ft.)	400	*****	
Salt/Min/Vit($/lb)	0.35	Interest Rate(%)	10	40.00	$/yr.
Hay($/lb dm)	0.04	Deprec. Rate(%)	5	20.00	$/yr.
Potatoes($/lb)	0.0075	Repairs(%)	3	12.00	$/yr.
Labor($/hr.)	6	Utilities(%)	0.25	1.00	$/yr.
Int. Rate(%)	10	Taxes(%)	1	4.00	$/yr.
Stocker Price($/lb	1.25		TOTAL	0.21	$/hd/day
Feeder Price($/lb)	1.15	FEEDING($/HR)		37.51	
Straw($/bale)	0.25	HUSBAND($/HR)		6.50	
		MANURE MANG($/HR)		67.50	

STOCKER PERIOD .....(TO 800 lbs.).....

	GRAIN		POTATO	
	QUANTITY	COST	QUANTITY	COST
DAYS	159		159	
FEED		(Gain at 2.2 lb/day)		
hay(dm lb/d)	12	76.32	2	12.72
grain(lb/d)	4	33.39		
Prot. Conc.(lb/d)	0.55	15.74	1.1	31.48
potatoes(lb/d)			66	78.71
salt/min/vit(lb/d)	0.11	6.12	0.11	6.12
HOUSING				
yardage		33.54		33.54
bedding	10	2.50	12	3.00
FEEDING(hr/day)	0.002	11.93	0.002	11.93
HUSBANDRY(hr/day)	0.016	16.54	0.016	16.54
MANURE MANG(hr/day	0.001	10.73	0.001	10.73
VET. & DRUGS		8.00		8.00
TOTAL STOCKER COST		214.81	*********	212.77
/DAY		1.35	*********	1.34

FINISHING PERIOD .....(TO 1100 lbs.).....

DAYS	107		107	
FEED	(Gain at 2.8 lb/day)		(Gain at 2.8 lb/day)	
hay(dm lb/d)	18	77.04	2.2	9.42
grain(lb/d)	6	33.71	0	0.00
Prot. Conc.(lb/d)	1	19.26	2.2	42.37
potatoes(lb/d)	0	0.00	96	77.04
salt/min/vit(kg/d)	0.33	12.36	0.33	12.36
HOUSING				
yardage		22.57		22.57
bedding	6	1.50	8	2.00
FEEDING(hr/day)	0.002	8.03	0.002	8.03
HUSBANDRY(hr/day)	0.016	11.13	0.016	11.13
MANURE MANG(hr/day	0.001	7.22	0.001	7.22
TOTAL FINISH COSTS	******	192.81	*********	192.14
/DAY		1.80	*********	1.80
GROSS EXPENSE		970.13	*********	967.40
Market Value		1265.00	*********	1265.00
NET RETURN to MANGEMENT		294.87	*********	297.60

OPTIUM BEEF PRODUCTION SYSTEM ANALYSIS

Grain $/lb		0.03	YARDAGE:		
Prot. Conc.($/lb)		0.18	Build.($10/sq ft.)	400	*****
Salt Min/Vit($/lb)		0.35	Interest Rate(%)	10	40.00 $/yr.
Hay($/lb dm)		0.04	Deprec. Rate(%)	5	20.00 $/yr.
Potatoes($/lb		0.006	Repairs(%)	3	12.00 $/yr.
Labor($/hr.)		6	Utilities(%	0.25	1.00 $/yr.
Int. Rate(%)		10	Taxes(%)	1	4.00 $/yr.
Stocker Price($/lb		1.25		TOTAL	0.21 $/hd/day
Feeder Price($/lb)		1.15	FEEDING($/HR		37.51
Straw($/bale)		0.25	HUSBAND($/HR)		6.50
			MANURE MANG $/HR)		67.50

STOCKER PERIOD .....(TO 800 lbs.).....

	GRAIN		POTATO	
	QUANTITY	COST	QUANTITY	COST
DAYS	159		159	
FEED		(Gain at 2.2 lb/day)		
hay(dm lb/d)	12	76.32	2	12.72
grain(lb/d)	4	19.08		
Prot. Conc.(lb/d)	0.55	15.74	1.1	31.48
potatoes(lb/d)			66	62.96
salt/min/vit(lb/d)	0.11	6.12	0.11	6.12
HOUSING				
yardage		33.54		33.54
bedding	10	2.50	12	3.00
FEEDING(hr/day)	0.002	11.93	0.002	11.93
HUSBANDRY(hr/day)	0.016	16.54	0.016	16.54
MANURE MANG(hr/day	0.001	10.73	0.001	10.73
VET. & DRUGS		8.00		8.00
TOTAL STOCKER COST		200.50	*********	197.03
/DAY		1.26	*********	1.24

FINISHING PERIOD .....(TO 1100 lbs.).....

DAYS	107		107	
FEED	(Gain at 2.8 lb/day		(Gain at 2.8 lb/day)	
hay(dm lb/d)	18	77.04	2.2	9.42
grain(lb/d)	6	19.26	0	0.00
Prot. Conc.(lb/d)	1	19.26	2.2	42.37
potatoes(lb/d)	0	0.00	96	61.63
salt/min/vit(kg/d)	0.33	12.36	0.33	12.36
HOUSING				
yardage		22.57		22.57
bedding	6	1.50	8	2.00
FEEDING(hr/day)	0.002	8.03	0.002	8.03
HUSBANDRY(hr/day)	0.016	11.13	0.016	11.13
MANURE MANG(hr/day	0.001	7.22	0.001	7.22
TOTAL FINISH COSTS	******	178.37	*********	176.73
	/DAY	1.67	*********	1.65
GROSS EXPENSE		941.37	*********	936.26
Market Value		1265.00	*********	1265.00
NET RETURN to MANGEMENT		323.63	*********	328.74

TABLE 1
ESTIMATED COMPONENT VALUE OF

POTATOES DELIVERED TO A WASHLINE

Quality Breakdown	Canada #1	Canada #2	Canada #1 small	Pickouts	Weighed Average Value (bbl)
Existing Packing House Value	53.5%	8.5%	8.0%	30%	
	6.00/bbl	5.00/bbl	3.00/bbl	0.50/bbl	4.03
Existing Grower Values	6.00/bbl	5.00/bbl	0	0	1.64
Grower with on-farm grading & livestock feeding.	6.00/bbl	5.00/bbl	$1.24/bbl	$1.24/bbl[1]	4.11[2]

Note:
1) Assuming feed value of $5.25/cwt barley
2) Net value of on-farm grading = $.47/bbl

APPENDIX III

COMMENTS ON THE DESIGN OF THE HARVEST SORTING MACHINE

The harvest sorting machine used during these experiments was a general purpose machine manufactured in Ontario. In addition to potatoes, this same machine may be used for turnips, carrots and onions. Thus by its nature the machine was not specifically designed for potatoes. It was apparent during these trials that several improvements could be made to the design of the machine, if it was desirable to have a machine designed specifically for potatoes.

Noted deficiencies on the machine used on these trials were as follows:

1) It was difficult to control the flow of potatoes over the various conveyors. This often resulted in an overload of potatoes on both the sizing and grading conveyors which cut down considerably on the efficiency of grading. This problem could be avoided by offering a variable speed on each conveyor.

2) There were 5 locations where the potatoes dropped from one conveyor to another as they passed over this machine. This is undesirable since it could result in bruising damage to the potatoes. At least one local processor who uses this machine for grading potatoes prior to processing has commented that the machine produces an undesirable level of bruising.

3) The sizing conveyor on the unit used was not long enough to efficiently remove all the small potatoes. Consideration should be given to extending this conveyor or else replacing it with a finger wheel sorter.

4) The lighting on the unit was not well designed, nor was it adequately waterproofed to be serviceable in an outdoor environment.

5) The grading work stations were poorly engineered. There were two steps beside the conveyor which resulted in some people standing too low to the grading table and others too high. As well, there was only one chute for discharging reject potatoes. The design could be improved by allowing for individual work stations with proper height, lighting and individual discharge chutes.

6) The elements of the roller bed were constructed of mild steel. This is prone to corrosion and could result in bruising of the potatoes.

7) The hopper at the foot of the dirt eliminating conveyor, into which the truck discharges its load, was poorly designed. It was subject to mechanical damage and spillage.

8) The height of the machine was excessive, to the point that for most New Brunswick storages, not enough of the machine could pass through the door to permit effective bin piling.

9) The culled material separated by this machine is discharged on both sides. There should be provision for attachment of additional conveyors to, for instance, deliver small potatoes directly from the grading table to a waiting truck.

10) There may be times when the farmer needs the piler but the grading table is not required. This could come about because the requirements for grading and sizing vary from season to season, and by the market to which the potatoes are delivered. A modular form of construction may be more appropriate for this type of machine so that the grading table would not have to be transported and used when it is not needed.

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